weather in South America by Señor Julio Bustos Navarrete on pages 120-121 of this REVIEW.

Meteorologists will place a large ? over the region here considered and watch the course of future events with much interest.

Dr. Murphy plans to publish an account of his studies in a forthcoming number of the Geographical Review.—*A. J. H.*

THE SEVERE TORNADOES OF MARCH 18, 1925

The details of loss of life and property caused by the severe tornadoes that occurred in the great central valleys on March 18 will be found in the table of "Severe local hail and wind storms March, 1925" in this issue of the REVIEW. An account of the storms as meteorological phenomena will appear in the April, 1925, issue.—*Ed.*

NOTES, ABSTRACTS, AND REVIEWS

LOCAL BRIGHTNESS OF ULTRA-VIOLET LIGHT

By F. W. PAUL GÖTZ

[Abstract by H. H. Kimball, from Verhandlungen der Schweizer. Naturforschenden Gesellschaft, Luzern, 1924, S. 109-111]

The measurements were made with a cadmium photoelectric cell at Arosa, Switzerland, elevation above sea level 1,860 meters, with auxiliary stations, functioning at intervals, at Chur, elevation 590 meters, Hörnligrat (Skihütte), elevation 2,500 meters, and Aroser Rathorn, elevation 3,000 meters.

The summarized results concern themselves principally with the following:

(1) The intensity of ultra-violet radiation in the spectral regions $\mu\mu > 320$ and $\mu\mu < 320$.

(2) Systematic investigations relative to the influence of elevation.

Results of measurements of solar radiation show that ultra-violet of the longer wave lengths has less seasonal variation than the shorter wave lengths, and that the spring intensities about equal the fall intensities. With increased elevation of the sun, and likewise with increased altitude above sea level, the annual amplitude diminishes in both spectral regions, but does not vanish with extrapolation to zero atmosphere. This conclusion makes desirable a verification of the measurements, with an eventual extension of the research to the stars.

Ratio of intensity, Arosa: Chur

Solar altitude	10°	15°	20°	30°	40°	60°
Red-ultra-red	1.21	1.14	1.13	1.09	1.07	1.09
Ultra-violet $>320\mu\mu$	3.52	2.79	2.04	1.53	1.49	1.48
Ultra-violet $<320\mu\mu$	3.33	2.32	1.86	1.45	1.39	1.33

The greater weakening in the ultra-violet region $\mu\mu > 320$ was unexpected, and is not fully explained.

The dark sky of the high mountains gives rather more ultra-violet light than the brighter sky of lower levels. The skylight shows a linear relation to solar altitude down to about 13°.

At Chur, the sun, even with its highest position, yields less ultra-violet < 320 $\mu\mu$ than does the sky. At Arosa it first equals the skylight at 52° elevation. At 2,500 meters the equality occurs with solar altitude 45°.

Instead of defining the local brightness as the overlight (the light received on a horizontal plane from the sun and sky), it has been considered to be the light radiated to the entire surface of a sphere, or one-sixth the overlight plus the front light of four sides, plus the underlight. The author states that when we take into account the 100 per cent (?) reflection from snow this removes the disagreement between physical and physiological results emphasized on the medical side in the relative pigment-forming power of spring and autumn light.

MARVIN AND DAY ON NORMALS OF DAILY TEMPERATURE IN UNITED STATES[1]

ALFRED J. HENRY

The publication under review is the second revision of the daily normals of temperature for Weather Bureau stations throughout the United States. It contains the daily normals for 161 individual stations as computed by a method which is believed to be superior to that used in computing previous normals.

The explanation of the methods used in the analysis, as given by the authors follows:

A true normal daily temperature can be computed with entirely sufficient accuracy only from a long series of values of 24 hourly temperatures for each day, derived from the maintenance of automatically-recording thermometers.

While the Weather Bureau has records of this character covering periods of 20 years or more at many stations, these are insufficient in number to adequately represent the details of climatic conditions of a great area like the United States, the period of time covered by such data is too short, and especially the labor of computing normals from hourly readings is too enormous to justify their general use for that purpose. On the other hand, observations of the daily extremes of temperature are available for probably as many as 10,000 stations for periods ranging from a few years in many cases to 50 years or more in a considerable number of cases. In addition, other observations at stated hours are also available and serve to fix appropriate diurnal normals which are nearly identical with so-called true normals derived from 24-hourly readings. In presenting the present series of station normals based on daily observations of the maxima and the minima of temperature, the close relation between such values and those based on hourly readings will be indicated, at least for the United States.

Previous normals.—Bulletin R of the Weather Bureau, published in 1908, contained tables of the daily normal temperatures based upon a 33-year record, 1873 to 1905, inclusive. These daily values were obtained by charting on large sheets of cross-section paper the average temperature for each of the 12 months, drawing a smooth curve through these values, and scaling therefrom the approximate daily averages. This plan is objectionable in that each of the 12 points on the scale indicating the values for the respective months covered too great a period in days to enable the approximate location of the points of highest and lowest temperatures, or to give an adequate idea of the rates of change during the various portions of the months. Furthermore, the length of record at that time, 33 years only, is recognized as too short to give dependable values from computed actual daily means.

The monthly means used in computing the values appearing in Bulletin R were obtained from the tri-daily observations, 7 a. m., 3 p. m., and 11 p. m., 75th meridian time, for the period 1873 to June, 1888, inclusive, and from the mean of the daily maximum and minimum temperatures from July, 1888, to the end of 1905. As the observations at stated hours were necessarily made at the same moment of time over all portions of the country, there was a constant and increasing earlier occurrence of the hours of observation to the westward. That is, at the first observation of the day, made at 7 a. m., say, for Philadelphia; the local time of observation at St. Louis would be an hour earlier, or 6 a. m.; at Denver it would be 2 hours earlier, or 5 a. m., and in California 3 hours earlier, or at 4 a. m.; the same conditions apply to the other observations. The means obtained from these data are, therefore, not strictly homogeneous throughout all parts of the country, due to the earlier hours of observation over the western portions.

In the early days of the service the means determined from the maximum and minimum readings were mainly worked out after the last observation of the day, usually 11 p. m. Later, when self-

[1] Marvin, C. F., and Day, P. C., Normals of temperature for the United States, 46-year period, July 3, 1875, to July 2, 1921, MONTHLY WEATHER REVIEW SUPPLEMENT No. 25, Washington, 1925.

recording instruments were introduced, the extremes were determined from midnight to midnight, local standard time. As both the maximum and minimum temperatures for the day usually occurred before the last observation, it is thought no important differences exist in the resulting means obtained from these readings over the different parts of the country.

With nearly 50 years of record now available for many stations it is possible to compute averages with considerable accuracy and the mean daily values submitted herewith are based upon averages uniformly determined from the daily extremes, and covering the period July 3, 1875, to July 2, 1921, 46 years of record. This series of means, unlike any previously used, as stated above, is practically homogeneous throughout the period of years considered, and the data from all parts of the country are placed upon a strictly comparable basis. The differences between the means obtained from the daily extremes and the true means, determined from hourly observations throughout the entire 24-hour period, are materially affected by local topography, distance from large bodies of water, etc. These differences were carefully analyzed by Professor Bigelow, appropriate corrections to the 24-hour means determined by him, and set forth by charts in Bulletin S of the Weather Bureau. The charts [not reproduced here.—*A. J. H.*] show how small the corrections generally are for the continental United States; on account of this smallness they have not been incorporated in the present tables.

Terminal adjustment.—Every complete cycle like the annual march of temperature must, of course, close upon itself, that is, the normal value for a given day at the beginning of the cycle must be identical with the value for the same day one year later. Average values for corresponding days even when derived from a long series of observations rarely or never satisfy this requirement. Quite a common practice among students in such cases consists in adjusting the two terminal values of the cycle to identity by distributing the discrepancy proportionately to all intermediate values of the whole series. This practice really has no physical basis of justification whatever in the case of many years of observations, because the discrepancy in question is characteristic of only a few values of the data immediately contiguous to the terminal values. Therefore, it is best in such cases to make no correction at all for terminal inequality, but to begin and end the cycle at a time when conditions fluctuate the least, that is, the summer season in the present case. Any outstanding discrepancy in the data itself will then be best disposed of by the subsequent mathematical analysis or by the drawing of smooth curves if that method is employed.

Choice of phase interval.—The superior advantages of the week as a sub-unit for the detailed analysis of the annual march of temperature are largely self-evident and were convincingly presented by one of the writers in the MONTHLY WEATHER REVIEW, August, 1919, 47: 544–555. Accordingly, this unit was adopted and daily averages of the maximum and minimum temperatures were prepared separately at all stations having 20 years of record or more. From these, weekly averages were computed. Although the schedule of weeks begins with January 1 to 7, so as to fit the calendar year, the tabulation of the data was made to begin with the week comprising the days July 3 to 9, so as to avoid the large terminal discrepancies which arise from a tabulation by calendar years. In leap years, the temperature for the 29th day of February was merged at ¼ weight with the week naturally comprising that date. Furthermore, the extra day over 52 weeks in all years was merged as an 8th day in the week beginning April 16. This date was chosen because the mean temperature for the year occurs about at this time and the inclusion of the extra day then would make the mean of the 52 weekly values of the data most nearly identical with the mean of the 365 individual days.

On account of the varying dates attending the beginning of observations at the respective stations it was considered that all stations having from 40 to 45 years of record were of sufficient length to give normals that would not be appreciably changed by the addition of the few years necessary to complete the full 46-year period. Of the stations appearing in the following tables, 93 had lengths of record varying from 40 to 46 years; the remainder, or 71, had lengths of record ranging from 20 to 39 years, and in these cases the records were corrected to the full 46-year period by the usual methods employed in such cases, that is, by comparing the shorter series with similar periods for near-by points and determining and applying the corrections necessary to reduce the weekly values to the full period of 46 years.

In accordance with the plan described in the foregoing, there were derived 52 weekly values of maximum and minimum temperatures for a total of 164 stations, well distributed over the continental United States and including the stations at Honolulu and San Juan, all (except the two last mentioned) adjusted to a period of 46 years. These constitute extremely valuable basic meteorological data and it is contemplated to publish them separately in full, together with a discussion of the residuals from the harmonic analysis and smooth curves.

METHODS OF ANALYSIS

Two methods were employed to derive daily normals from the weekly averages.

First method.—For the 93 stations having 40 or more years of records, the weekly means were subjected to a four-term Fourier analysis and 52 values of normal temperatures were computed therefrom. These, of course, were separated from each other by an exact interval of $7\frac{1}{52}$ days. By an appropriate and progressive adjustment these computed values were transformed to 52 values at intervals of exactly 7 days, except that the 52d week, beginning June 26, was made to contain 8 days.

It is considered unnecessary to outline the arithmetical processes followed in computing these weekly values, but they are recognized as superior to the methods usually followed in drawing free-hand curves through the observed data. From these weekly normals intermediate daily values were easily interpolated for both the maximum and minimum separately. The mean of the two normal extremes is considered to give a normal daily mean temperature of great significance, and these are the values given in the accompanying tables.

Second method.—For stations with a length of record from 20 to 39 years the final daily values of the normal maximum and the normal minimum temperatures were obtained by drawing smooth curves through the 52 weekly averages and scaling the daily values therefrom, similar to the manner of obtaining the data given in Bulletin R previously explained, save that the number of points available for plotting was increased from the 12 mean monthly values to 52 means for the respective weeks, the increase in the number of points affording opportunity to produce a curve upon which could be located with considerable accuracy the extreme points, and the proper rate of change in the varying portions of the month.

This supplement is not for general free distribution. It will be sent free to cooperating meteorological services and institutions, and to individuals and organizations that have cooperated with the Bureau in this research. Copies of the Supplement may be had from the Superintendent of Documents, Washington, D. C., at the price of 20 cents. Remittances should be made to that official and not to the Weather Bureau.

COTTON GROWING IN RELATION TO CLIMATE IN EGYPT AND THE SUDAN

[Abstracted by J. B. Kincer from Technical and Scientific Service Bull. No. 47, of the Ministry of Agriculture, Egypt]

In 1923, the Ministry of Agriculture of Egypt published a report by Mr. C. B. Williams on the cotton plant in relation to temperature and rainfall, (Technical Bulletin No. 32, Cairo), which was abstracted for the June, 1924, number of this Review, pages 306 and 307. In a more recent bulletin (No. 47, 1924), the same author treats of climatic conditions and their relation to the growth of cotton in Egypt and the Sudan. The climatic factors considered are temperature, moisture, wind, and light.

This study is of unusual interest because of the fact that cotton in Egypt, grown principally in the extreme lower Nile Valley, is a summer crop, while in the Sudan, extending from the central and southern districts of the Red Sea westward to the upper Nile Valley, it is grown as a winter crop. In Egypt the seeds are planted on a rising temperature, usually when the mean daily values rise to about 60°, while in the Sudan they are planted on a falling temperature, ranging from 90° to 80°. The lowest temperature of record at any of the Egyptian stations in the cotton area is 25°, while in the Sudan the lowest of record is 37°, and by reason of the difference in the time of the cotton season, the growing plants escape the extreme cold in Egypt and the extreme heat of the Sudan.

In both sections cotton is mainly, but not entirely, dependent upon irrigation. There are a few places in the southern Sudan where it is grown under natural